Catalog of FEMA Earthquake Resources

FEMA P-736A / December 2010

FEMA

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How to Obtain Publications

Throughout this catalog, the following symbols are used to indicate whether each publication is available online, in print, or on a compact disc (CD):

Available online Available in print Available on CD

Some publications are available in only one of these formats, while others are available in multiple formats.

To view or download publications that are available online –
Please visit http://www.fema.gov/plan/prevent/earthquake/pubindex.shtm, or http://www.fema.gov/library.

To order copies of publications in print or on CD –
please call the FEMA Distribution Center at 1–800–480–2520, fax 1-240-699-0525 (Monday-Friday 8:00 a.m. – 5:00 p.m., EST), or email your order to FEMA-Publications-Warehouse@dhs.gov.

This catalog is available online at http://www.fema.gov/library/viewRecord.do?=3538.

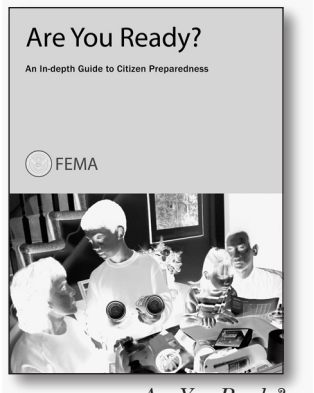
Cover photograph courtesy of: BRI Consulting Group.

FEMA Earthquake Publications

Individuals and Homeowners

Are You Ready? An In-depth Guide to Citizen Preparedness. (FEMA IS-22)

This guide provides citizens with step-by-step procedures on how to develop, practice, and maintain emergency plans for protecting lives and property before, during, and after a disaster. Also included is information for individuals and their families on how to assemble a disaster supplies kit with a sufficient quantity of food, water, and other supplies. The guide is also available in the Spanish language.



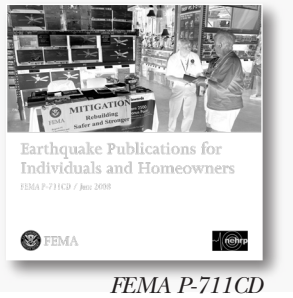
Are You Ready?

Earthquake Home Hazard Hunt Poster. (FEMA 528)

This poster provides visuals and descriptions so that homeowners can identify and fix at-risk areas of their homes to reduce future earthquake damage and disruption.

Earthquake Publications for Individuals and Homeowners. (FEMA P-711CD)

This CD–ROM compilation contains all of the publications listed in this section (Individuals and Homeowners) of the catalog. Two additional publications are also included: *Drop, Cover, and Hold Poster* (FEMA 529); and *The Adventures of Terry the Turtle and Gracie the Wonder Dog, Grades 3–6* (FEMA 531).



FEMA P-711CD

Earthquake Safety Checklist. (FEMA B-526)

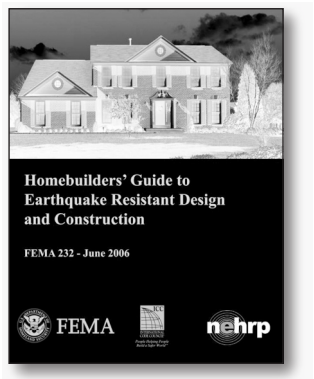
This quick-reference guide helps individuals and families prepare for an earthquake and prevent earthquake-related damage to their homes. The easy-to-read brochure features instructions on conducting earthquake drills and "hazard hunts." Also included are a checklist of disaster supplies, tips on what to do during and after an earthquake, and additional resources. Available in English and Spanish in print, and multiple languages online.

Earthquake Safety Guide for Homeowners. (FEMA 530)

This updated safety guide, which was originally developed and published by the California Seismic Safety Commission, provides homeowners with a good start to strengthening their homes against earthquake damage. The guide also illustrates the relative cost of prevention versus repair or replacement.

Homebuilders' Guide to Earthquake Resistant Design and Construction. (FEMA 232)

This illustrated guide presents seismic design and construction guidance for one- and two-family light frame residential structures that can be utilized by homebuilders, knowledgeable homeowners, and other non-engineers, and provides information supplemental to the 2003 edition of the *International Residential Code*. The guide presents background information on the principles of seismic resistance and how earthquake forces impact conventional residential construction and more detailed information on architectural considerations (site selection, foundations and foundation details, floors, shear walls, and roofs). Also included are discussions of masonry and stone elements, examples of typical floor plans for earthquake-resistant one- and two-story homes, excerpts of seismic requirements from building codes, and checklists for homebuilders. The guide also presents a series of "above-code recommendations" that provide low-cost measures that would increase the performance of the building and help keep it functional after an earthquake.



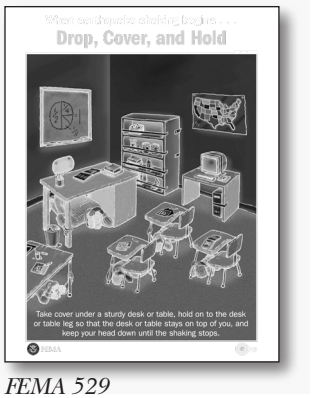
FEMA 232

Reducing the Risks of Nonstructural Earthquake Damage: A Practical Guide. Third Edition. (FEMA 74)

This well-illustrated publication describes the sources of nonstructural earthquake damage and provides information on effective methods of reducing potential risks from such damage. It assists in identifying potential hazards and provides specific guidance on upgrades that readers can do themselves. The guide also contains diagrams and photographs, a glossary, references, and an annotated bibliography for those who wish additional information. A nonstructural inventory form, a checklist of nonstructural earthquake hazards, and an explanation of nonstructural risk ratings are included as appendices. The target audiences for the guide are building owners, facility managers, maintenance personnel, homeowners, store or office managers, business proprietors, organizational department heads, and others concerned with building safety and the continuation of business.

Reducing the Risks of Nonstructural Earthquake Damage: A Practical Guide. Fourth Edition. (FEMA E-74)

A web-based fourth edition of this publication was recently released on the Internet. It has been updated and redesigned for use online and expanded to include more examples, complete with photos of actual damage and details illustrating correct mitigation measures. The new online format makes it simple to browse and print out relevant details. The publication is located at http://www.fema.gov/plan/prevent/earthquake/fema74/index.shtm or http://www.atcouncil.org/FEMA74/FEMA74index.html.



FEMA 529

FEMA P-710CD

Teachers and Kids

Drop, Cover, and Hold Poster. (FEMA 529)

This poster is intended for classroom use. The poster depicts a teacher and students in a classroom responding appropriately to the first sign of an earthquake (Drop, Cover, and Hold). Available in English and Spanish in print, and multiple languages online.

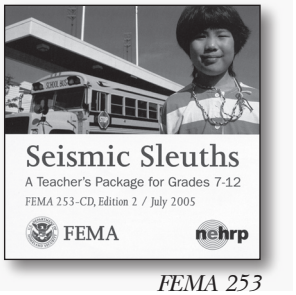
Earthquake Publications for Teachers and Kids. (FEMA P-710CD)

This CD–ROM compilation contains all of the publications listed in this section (Teachers and Kids) of the catalog. Two additional publications are also included: *Earthquake Safety Checklist* (FEMA B-526), and *Earthquake Home Hazard Hunt Poster* (FEMA 528).

Earthquake Safety Activities for Children and Teachers. (FEMA 527)

This updated publication provides elementary school teachers with ready-to-use, hands-on activities that explain what happens during an earthquake, how to prepare for earthquake shaking, and how to stay safe during and after an earthquake. Included are a variety of handouts for students, including maps, songs, “hazard hunt” worksheets, and earthquake safety checklists.

Seismic Sleuths: A Teacher's Package for Grades 7–12. (FEMA 253)

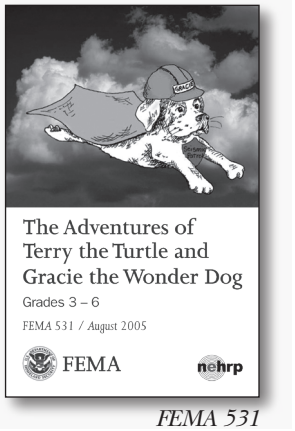


FEMA 253

This package provides middle and high school teachers with information about the causes and effects of earthquakes. Activity sheets for students and background materials for teachers are provided in each of the volume's six units. The units assess students' knowledge about earthquakes and provide information about preparedness and emergency management; discuss the causes of earthquakes and their effects; present information on seismic waves and the development of seismology and instruments used to measure an earthquake's magnitude; explain the effects of earthquakes on buildings and earthquake-resistant design techniques; and discuss earthquake preparedness and the reactions of different populations to historical earthquakes. The last unit provides a variety of summary and assessment activities and a list of additional resources.

The CD–ROM, FEMA 253CD, Second Edition, 2005, contains the previously printed curriculum supplements that provide middle and high school teachers with background materials and activity sheets for students.

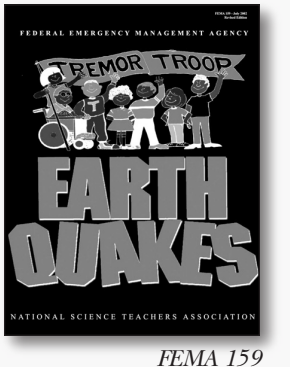
The Adventures of Terry the Turtle and Gracie the Wonder Dog, Grades 3–6. (FEMA 531)



FEMA 531

This storybook for children in grades 3–6 relates the adventures of the safety-conscious mayor of Shakeyville (Terry the Turtle) and a team of safety volunteers who meet with students at the local elementary school to teach them about earthquake safety. The students discover the importance of earthquake safety and preparedness. Included are suggestions for creating a disaster kit, illustrations of what to do if an earthquake happens (Drop, Cover, and Hold), and a list of resources.

Tremor Troop: Earthquakes—A Teacher's Package for K–6. Revised Edition. (FEMA 159)



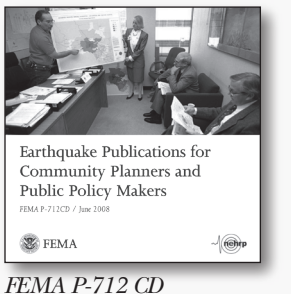
FEMA 159

This teacher's package for grades K–6 provides ready-to-use, hands-on activities for students and teachers on the science of earthquakes and earthquake safety. This edition contains assessments throughout the units, matrices linking activities to the National Science Education Standards, and a new glossary. Four of the five units are divided into levels by grades: Level 1, for grades K–2; Level 2, for grades 3–4; and Level 3, for grades 5–6. The lessons introduce how earthquakes are defined, why and where earthquakes occur, the physical results of earthquakes, and how earthquakes are measured. The fifth and final unit addresses earthquake safety and survival and includes activities for students in all grades K–6. At the end of each unit, ready-to-reproduce masters are provided for classroom use.

Community Planning and Public Policy

Creating a Seismic Safety Advisory Board: A Guide to Earthquake Risk Management. (FEMA 266)

This guide assists states, state coalitions, and local governments in creating, developing, and nurturing seismic safety advisory boards. The guide provides information on board operations, including staffing and funding a board, and guidelines for strategic planning and developing a model seismic risk management program to measure progress. The appendices include model executive orders, enabling legislation, staff duty descriptions, workshop designs, and workshop rosters; examples of an interstate compact, articles of incorporation, and corporate bylaws; a list of existing seismic safety advisory boards; and a lexicon of terms.



FEMA P-712 CD

Earthquake Publications for Community Planners and Public Policy Makers. (FEMA P-712 CD)

This CD–ROM compilation contains most of the publications that provide information and guidance for local planners, policy makers, and advocates interested in assessing and responding to seismic hazards and the risks they pose for their communities. Six of these publications are offered individually in this catalog (FEMA 83, 154, 266, 275, 366, and 474). Also included are *Societal Implications: Selected Readings* (FEMA 84), *Seismic Retrofit Incentive Programs: A Handbook for Local Governments* (FEMA 254), and a series of mitigation planning "how-to" guides (FEMA 386-1 through 386-8) applicable to earthquakes and other hazards.

Earthquake-Resistant Design Concepts: An Introduction to the NEHRP Recommended Seismic Provisions. (FEMA P-749)

This document provides a readily understandable explanation of the intent and requirements of seismic design in general and the *NEHRP Recommended Seismic Provisions for New Buildings and Other Structures* (FEMA P-750) in particular. FEMA P-750 and the building codes and standards based on its recommendations are technical documents intended primarily for use by design and construction professionals. However, understanding the basis for the seismic regulations contained in the Nation's building codes and standards is important to many people outside this technical community. This publication is designed for elected officials, members of the insurance and financial communities, individual business owners, and other interested individuals.

Establishing Programs and Priorities for the Seismic Rehabilitation of Buildings: Handbook. (FEMA 174)

This handbook and its supporting report (FEMA 173) provide the information needed to develop a seismic rehabilitation program and establish priorities for rehabilitation. Through the presentation of nationally applicable guidelines, the handbook helps local jurisdictions to make informed decisions about rehabilitating seismically hazardous existing buildings. Included are a review of the relevant technical and societal issues and a procedure to resolve these issues.

Establishing Programs and Priorities for the Seismic Rehabilitation of Buildings: Supporting Report. (FEMA 173)

This publication is a supporting report to *Establishing Programs and Priorities for the Seismic Rehabilitation of Buildings: Handbook* (FEMA 174). It includes additional information and commentary, annotated bibliographies, and reproductions of selected laws and ordinances that are summarized in FEMA 174.

Available online Available in print Available on CD

Financial Incentives for Seismic Rehabilitation of Hazardous Buildings – An Agenda for Action. Volume 1: Findings, Conclusions, and Recommendations. (FEMA 198)

The Financial Incentives series publications (Volumes 1–3, FEMA 198, FEMA 199, and FEMA 216) identify and describe the existing and potential regulatory and financial mechanisms and incentives for lessening the risks posed by existing buildings in an earthquake. Volume 1 includes a discussion of the methodology used in this series, background information on financial incentives, and findings, conclusions, and recommendations for decision makers at the local, state, and national levels.

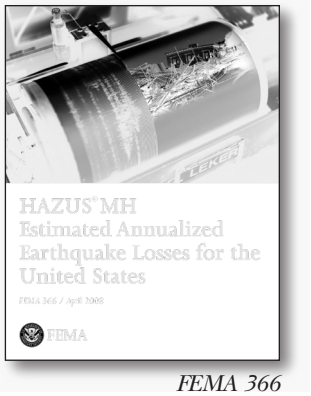
Financial Incentives for Seismic Rehabilitation of Hazardous Buildings – An Agenda for Action. Volume 2: State and Local Case Studies and Recommendations. (FEMA 199)

The Financial Incentives series publications identify and describe the regulatory and financial mechanisms and incentives for lessening the risks posed by existing buildings. Volume 2 includes detailed descriptions of the 20 case studies that were examined as part of the project.

Financial Incentives for Seismic Rehabilitation of Hazardous Buildings – An Agenda for Action. Volume 3: Applications Workshops. (FEMA 216)

The Financial Incentives series publications identify and describe the regulatory and financial mechanisms and incentives for lessening the risks posed by existing buildings. Volume 3 provides an account of workshops conducted to develop local agendas for action. It includes directions for convening additional workshops and teaching materials that can be used in workshops. Groups interested in planning local seismic rehabilitation programs can use this document as a guide to convene a workshop to initiate the process.

HAZUS® MH Estimated Annualized Earthquake Losses for the United States. (FEMA 366)



FEMA 366

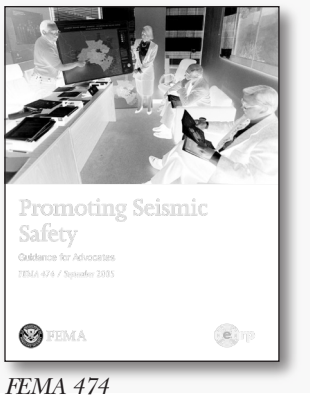
Recent earthquakes around the world show a pattern of steadily increasing damages and losses that is due primarily to two factors: 1) significant growth in earthquake-prone urban areas, and 2) vulnerability of the older building stock, including buildings constructed within the past 20 years. This publication highlights the impacts of both high risk and high exposure on losses caused by earthquakes. It is based on loss estimates generated by HAZUS–MH. The HAZUS tool provides a method for quantifying future earthquake losses. The objective of this study is to assess levels of seismic risk in the United States using HAZUS–MH and nationwide data. The analysis computes two interrelated metrics to characterize earthquake risk: Annualized Earthquake Loss (AEL) and the Annualized Earthquake Loss Ratio (AELR).

Landslide Loss Reduction: A Guide for State and Local Government Planning. (FEMA 182)

This guide provides information for state and local officials involved in landslide mitigation. The chapters describe the benefits of landslide mitigation; causes and types of landslides; hazard identification, assessment, and mapping; the transfer and use of information; loss-reduction techniques; plan preparation and review; and approaches to overcoming problems. Illustrations provide additional information on the causes of and damage resulting from landslides.

Planning for Seismic Rehabilitation: Societal Issues. (FEMA 275)

This publication provides users with an understanding of the social and public policy issues that may accompany seismic rehabilitation, such as demographic, social, and economic impacts; historic property restrictions; resident dislocations; and business interruptions. The publication presents a four-step decision process to assist local officials, private owners, and design professionals in determining the need for rehabilitation. It includes an "escalation ladder" to assist in understanding the degree of conflict that might be generated and the implications of choosing particular strategies.



FEMA 474

Promoting Seismic Safety: Guidance for Advocates. (FEMA 474)

This booklet offers advice to assist seismic safety advocates in presenting risk-reduction information and ideas. The full version of *Promoting Seismic Safety: Guidance for Advocates* is a 200-plus page report that consists of two parts. Part One is the guidance provided in this booklet. Part Two is a set of background papers developed by the authors as part of the project. PDF files for Part Two can be downloaded from the MCEER website at http://mceer.buffalo.edu/publications/tricenter/04-SP02/default.asp.

Promoting the Adoption and Enforcement of Seismic Building Codes: A Guidebook for State Earthquake and Mitigation Managers. (FEMA 313)

This guidebook provides background information and educational materials to help state officials promote the adoption, administration, and enforcement of state and local model building codes that contain the latest seismic provisions. The guidebook describes the purpose, function, and effectiveness of building codes in general and seismic codes in particular and presents a step-by-step process for adopting and administering state or local codes. The appendices include the history and principles of seismic design; a state-by-state listing of state codes and code influences; seismic design practices in the United States; examples of state and local building codes and state legislation; services of three model code organizations in the United States; and resources, recommended readings, and educational materials.

Seismic Considerations for Communities at Risk. (FEMA 83)

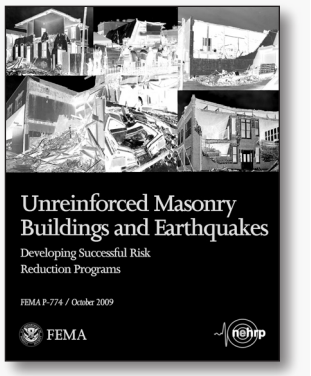
This publication provides individuals and community decision makers with information that they can use to assess seismic risk, make informed decisions about seismic safety in their communities, and determine what can be done to mitigate risk. The publication includes information on the scope of earthquake risk in the United States, the effects of earthquakes on buildings, how design can reduce earthquake effects, and the importance of seismic codes and the *NEHRP Recommended Seismic Provisions.* Also included are factors to consider when deciding whether and how to take action to reduce earthquake risk and suggestions for stimulating community action.

Seismic Rehabilitation of Buildings: Strategic Plan 2005. (FEMA 315)

This publication discusses the mission, history, and results of FEMA's Existing Building Program (EBP) and provides four objectives and 25 tasks to be carried out through the EBP. The four objectives are to: 1) promote seismic rehabilitation and advance the implementation of previously developed materials; 2) monitor the use of and refine existing materials; 3) develop new seismic rehabilitation tools; and 4) consider new program directions for the EBP. Estimated costs for the next 10–15 years and guidelines for plan implementation are also included. The plan broadens the EBP's original goal by emphasizing the protection of the Nation's economy. The publication describes how this can be accomplished by limiting fatalities, life-threatening injuries, and property and economic losses from earthquakes through an increase in the number of seismically-resistant buildings in all regions at risk for earthquakes.

Unreinforced Masonry Buildings and Earthquakes: Developing Successful Risk Reduction Programs. (FEMA P-774)

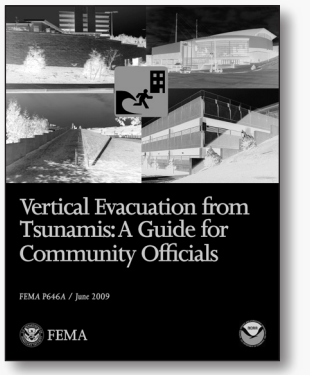
This publication provides guidance on reducing the risks from unreinforced masonry (URM) buildings in seismically active areas. URM buildings are typically the most vulnerable to earthquake damage and the type of construction that is most commonly singled out for voluntary and mandatory seismic risk reduction programs. The document includes illustrations and photographs of URM buildings and describes their seismic vulnerabilities. It discusses policy and regulatory issues that often must be considered, such as retrofit costs, the economic viability of older buildings, numbers of occupants and types of use, and historic or architectural values. Rather than prescribing a rigid sequence of steps for URM risk reduction, FEMA P-774 documents a wide variety of successful approaches that have been developed across the United States.



FEMA P-774

Vertical Evacuation from Tsunamis: A Guide for Community Officials. (FEMA P646A)

This document provides guidance for local officials on how to implement the design guidelines detailed in *Guidelines for Design of Structures for Vertical Evacuation from Tsunamis* (FEMA P646). It examines how communities can plan, fund, construct, operate, and maintain vertical evacuation refuges.



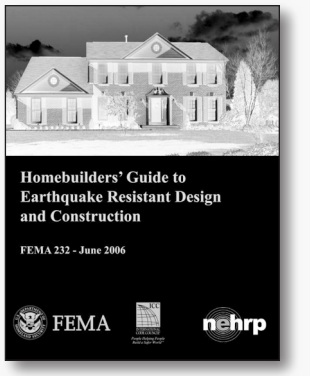
FEMA P-646A

Building Professionals and Engineers

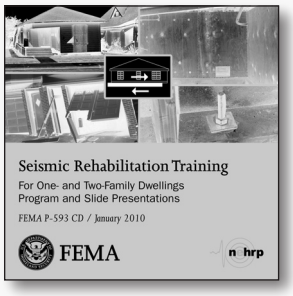
Residential

Homebuilders' Guide to Earthquake Resistant Design and Construction. (FEMA 232)

This illustrated guide presents seismic design and construction guidance for one- and two-family light frame residential structures that can be utilized by homebuilders, knowledgeable homeowners, and other non-engineers, and provides information supplemental to the 2003 edition of the *International Residential Code*. The guide presents background information on the principles of seismic resistance and how earthquake forces impact conventional residential construction and more detailed information on architectural considerations (site selection, foundations and foundation details, floors, shear walls, and roofs). Also included are discussions of masonry and stone elements, examples of typical floor plans for earthquake-resistant one- and two-story homes, excerpts of seismic requirements from building codes, and checklists for homebuilders. The guide also presents a series of "above-code recommendations" that provide low-cost measures that would increase the performance of the building and help keep it functional after an earthquake.



FEMA 232



FEMA P-593 CD

Seismic Rehabilitation Training for One and Two Family Dwellings: Program and Slide Presentations. (FEMA P-593CD)

This CD-only product contains PowerPoint slide presentations, an instructional guide, and speaker's notes for training contractors, code officials, and other parties interested in the seismic retrofitting of existing light frame dwellings. This product has been used by the International Code Council as the basis for a series of webinars that have been presented to its membership.

New Buildings

Communicating with Owners and Managers of New Buildings on Earthquake Risk. (FEMA 389)

This publication facilitates the education of building owners and managers on the seismic risk management tools that can be effectively and economically employed during the building development phase. The document, which is intended primarily for design professionals, introduces and discusses: 1) seismic risk management and the development of a risk management plan; 2) emerging concepts in performance-based seismic design; and 3) seismic design and performance issues related to six specific building occupancies: commercial office facilities, retail commercial facilities, light manufacturing facilities, health care facilities, local schools (K–12), and higher education (university) facilities. The document also provides guidance for identifying and assessing earthquake-related hazards during the site selection process.

Design Guide for Improving Hospital Safety in Earthquakes, Floods, and High Winds: Providing Protection to People and Buildings. (FEMA 577)

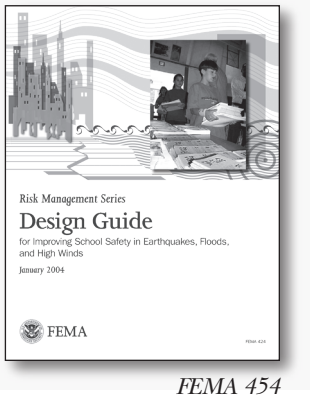
This guide provides state-of-the-art knowledge on the variety of vulnerabilities faced by hospitals exposed to earthquakes, flooding, and high-winds risks, as well as the best ways to mitigate the risk of damage and disruption of hospital operations caused by these events. The information presented in this publication provides an exhaustive review of mitigation measures and design solutions that can improve the safety of hospitals in natural hazard events. However, this publication is not intended to be a comprehensive mitigation design manual that the reader can use to develop actual plans and specifications. It is intended as an introduction to the fundamental principles of natural-hazard risk reduction, with an emphasis on mitigation planning and the design of hospital buildings.

FEMA 424

Design Guide for Improving School Safety in Earthquakes, Floods, and High Winds. (FEMA 424)

This guide provides design guidance for the protection of school buildings (K–12) and their occupants against natural hazards. It focuses on the design of new schools but the repair, renovation, and expansion of existing schools is also addressed. The guide introduces two core concepts: multihazard design and performance-based design. The guide emphasizes that identification of hazards and their frequency must be considered and integrated with all other design concerns from the inception of the site-selection and building-design process.

Designing for Earthquakes: A Manual for Architects. (FEMA 454)



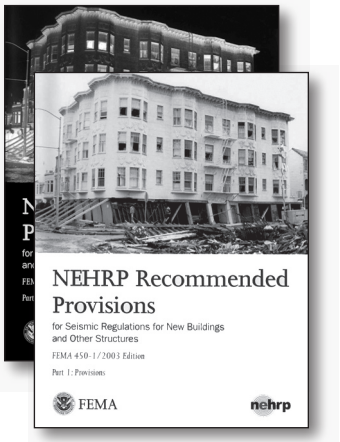
FEMA 454

This publication explains the principles of seismic design in ways that are easy to understand for those without a technical background in engineering and seismology. Although intended primarily for architects, the publication may also be of interest to building officials, owners, managers, and tenants as well as emergency management personnel, engineers, and others concerned with the seismic protection of buildings. Topics covered include the nature of seismic hazards, how buildings are affected by earthquake-induced ground motion, building site selection and assessment, how design decisions affect building seismic performance, seismic codes and performance-based design, the historical development of earthquake-resistant design, common retrofit techniques for existing buildings, protection of nonstructural components, and how earthquake protection relates to protection from other hazards.

Earthquake-Resistant Design Concepts: An Introduction to the NEHRP Recommended Seismic Provisions. (FEMA P-749)

This document provides a readily understandable explanation of the intent and requirements of seismic design in general and the *NEHRP Recommended Seismic Provisions for New Buildings and Other Structures* (FEMA P-750) in particular. FEMA P-750 and the building codes and standards based on its recommendations are technical documents intended primarily for use by design and construction professionals. However, understanding the basis for the seismic regulations contained in the Nation's building codes and standards is important to many people outside this technical community. This publication is designed for elected officials, members of the insurance and financial communities, individual business owners, and other interested individuals.

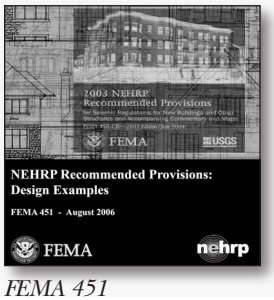
NEHRP Recommended Provisions and Commentary for Seismic Regulations for New Buildings and Other Structures. 2003 Edition. (FEMA 450 and FEMA 450CD)



FEMA 450. Part 1 and Part 2

The 2003 edition of the *NEHRP Recommended Provisions* was the seventh update of this important resource document, which was first published in 1985. The Provisions documents present criteria for the design and construction of new buildings, of additions and alterations to existing buildings, and of non-building structures to enable them to resist the effects of earthquake ground motions. The publication is one of the main resources for the development of national seismic design standards and codes. This edition consists of two volumes: FEMA 450–1 (Part 1: Provisions) and FEMA 450–2 (Part 2: Commentary). Featured updates include: revised foundation and concrete-structure design requirements, simplified design procedures, nonlinear static analysis, comprehensive design with energy-dissipating devices, and design guidelines for steel moment-frame structures developed in response to the 1994 Northridge earthquake. Most of this material was adopted into the ASCE/SEI 7–05 standard and the 2006 edition of the *International Building Code.*

The CD–ROM, FEMA 450CD, contains FEMA 450–1 and FEMA 450–2 and the related seismic design maps, including the maximum considered earthquake (MCE) maps. The CD also includes the U.S. Geological Survey's design map value calculation software as well as two earlier editions of the Provisions (1997 and 2000).



FEMA 451

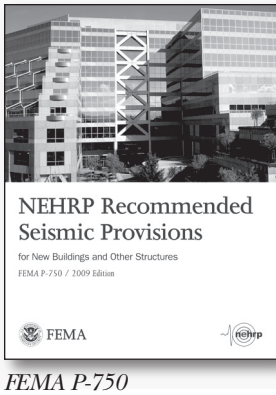
NEHRP Recommended Provisions: Design Examples. (FEMA 451)

This publication provides a series of design examples using the 2003 edition of the *NEHRP Recommended Provisions* for different types of construction materials and building configurations. These design examples demonstrate the design procedures used in the *NEHRP Recommended Provisions*, which serves as the basis for the seismic provisions in the Nation's building codes, and make an excellent training tool.

FEMA 451B

NEHRP Recommended Provisions for New Buildings and Other Structures: Training and Instructional Materials. (FEMA 451B)

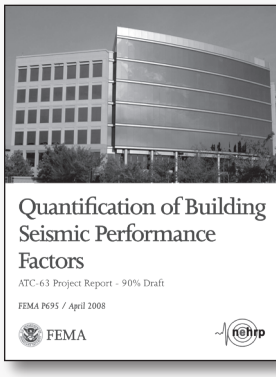
These instructional materials are for use with the *NEHRP Recommended Provisions: Design Examples* (FEMA 451) and provide a means for gaining additional knowledge about earthquake engineering as presented in the 2003 edition of the *NEHRP Recommended Provisions* (FEMA 450). These materials can be presented to engineers or architects by a qualified speaker with expertise in the practice of earthquake engineering, used by an individual who wishes to enhance his or her understanding of earthquake engineering, or applied by engineering academics as the basis for classroom instruction on earthquake-resistant design. Also available online at http://www.nibs.org/index.php/bssc/publications/2003/fema451btraining.



FEMA P-750

NEHRP Recommended Seismic Provisions for New Buildings and Other Structures. 2009 Edition. (FEMA P-750)

The *NEHRP Recommended Seismic Provisions* is a resource document for improving national seismic design standards and model building codes. It has been the primary source of seismic design requirements for various model building codes and design standards since the early 1990s. This 2009 edition of the *NEHRP Provisions* is significantly different from previous editions in that the ASCE/SEI 7–05 standard, *Minimum Design Loads for Buildings and Other Structures,* and the standards therein are adopted by reference, allowing it to focus on its role as a resource document for introducing new concepts and design methods and translating research results for practical implementation. The document consists of three parts: Part 1 presents recommended modifications to ASCE/SEI 7–05, including new seismic design maps based on the USGS national seismic hazard maps; Part 2 is a completely rewritten commentary following the ASCE/SEI 7 chapter structure; and Part 3 contains a collection of 13 resource papers on emerging seismic design concepts and issues. A separate series of design examples and related educational materials are currently being developed and are scheduled for release in 2011.



FEMA P-695

Quantification of Building Seismic Performance Factors. (FEMA P-695)

This publication presents a recommended methodology for reliably quantifying building system performance and response parameters for use in seismic design. The parameters or "seismic performance factors" addressed include the response modification coefficient (R factor), system overstrength factor, and deflection amplification factor. The methodology is a refinement of an earlier preliminary methodology, and is based on a review of relevant research on nonlinear response and collapse simulation, benchmarking studies of selected structural systems, feedback from an expanded group of experts and potential users, and evaluations of additional structural systems conducted to verify the technical soundness and applicability of the approach.

Existing Buildings

Incremental Seismic Rehabilitation Publications. (FEMA 395–400 and FEMA P-420)

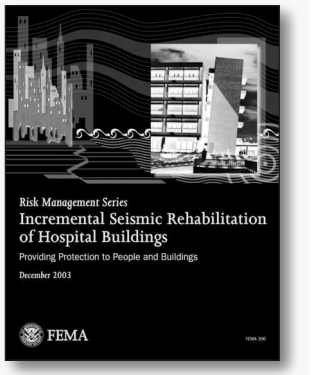
These publications present an innovative approach that phases a series of discrete rehabilitation, or retrofitting, actions implemented over a period of several years. *Incremental seismic rehabilitation* is an effective, affordable, and non-disruptive mitigation strategy, and can be integrated into ongoing facility maintenance and capital-improvement operations to minimize cost and disruption. The publications in the series address different occupancies, including schools, hospitals, apartment buildings, office buildings, and hotels, and target building owners, facility managers, financial and risk managers, and others who have a role in building safety and loss reduction. A companion manual targeted to engineers and design professionals (FEMA P-420) is also available.

FEMA 395, *Incremental Seismic Rehabilitation of School Buildings* (K–12)

This manual provides school administrators and board members with the information they need to assess the seismic vulnerability of existing school buildings and to implement a program of incremental seismic rehabilitation.

FEMA 396, *Incremental Seismic Rehabilitation of Hospital Buildings*

This manual provides health care administrators and board members with the information they need to assess the seismic vulnerability of hospitals and other existing health care facilities, and to implement a program of incremental seismic rehabilitation.



FEMA 396

FEMA 397, *Incremental Seismic Rehabilitation of Office Buildings*

Office buildings may be owned by partnerships, individuals, pension funds, real estate investment trusts, and other entities. This manual provides the information that these owners need to assess the seismic vulnerability of their buildings and to implement a program of incremental seismic rehabilitation.

FEMA 398, *Incremental Seismic Rehabilitation of Multifamily Apartment Buildings*

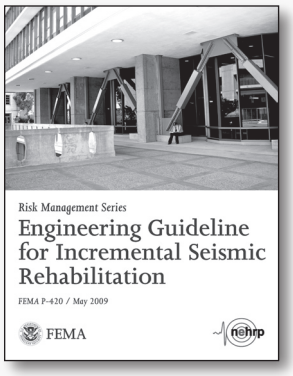
This manual is designed for partnerships, individuals, pension funds, real estate investment trusts, and other entities who own Class A, B, or C multifamily buildings. It provides the information that these owners need to assess the seismic vulnerability of their buildings and to implement a program of incremental seismic rehabilitation.

FEMA 399, *Incremental Seismic Rehabilitation of Retail Buildings*

This manual is targeted to partnerships, individuals, pension funds, real estate investment trusts, and other entities who own Class A, B, or C retail buildings. It provides the information that these owners need to assess the seismic vulnerability of their buildings and to implement a program of incremental seismic rehabilitation.

FEMA 400, *Incremental Seismic Rehabilitation of Hotel/Motel Buildings*

This manual provides the owners of hotels and motels with the information they need to assess the seismic vulnerability of their buildings and to implement a program of incremental seismic rehabilitation.



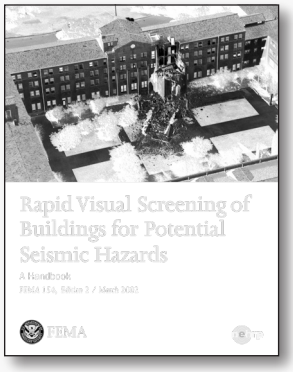
FEMA 420

FEMA P-420, ***Engineering Guideline for Incremental Seismic Rehabilitation***

This publication provides guidance for engineers and architects on implementing programs of incremental seismic rehabilitation for building owners. It reviews all FEMA publications that contain information on seismic evaluation and rehabilitation of existing buildings, and provides guidance on how to apply that information to incremental seismic rehabilitation programs.

Prestandard and Commentary for the Seismic Rehabilitation of Buildings. (FEMA 356)

This prestandard serves as a nationally applicable tool for design professionals, code officials, and building owners undertaking the seismic rehabilitation, or retrofitting, of existing buildings. Chapters include requirements; analysis procedures; foundations and geologic site hazards; steel; concrete; masonry; wood and light metal framing; seismic isolation and energy dissipation; simplified rehabilitation; architectural, mechanical, and electrical components; and use of the Prestandard for risk mitigation programs. FEMA 356 has been superseded by American Society of Civil Engineers ASCE 41, *Seismic Rehabilitation of Buildings,* but is being maintained by FEMA as a reference document.



FEMA 154

Rapid Visual Screening of Buildings for Potential Seismic Hazards: A Handbook. Second Edition. (FEMA 154)

The Rapid Visual Screening (RVS) handbook can be used by trained personnel to identify potentially hazardous buildings **before an earthquake**. The RVS procedure comprises a method and several forms that help users quickly identify, inventory, and rank such buildings according to their expected safety and usability during and after earthquakes. The structural scoring system has been revised, based on new information, and the handbook has been shortened and focused to make it easier to use. The target audiences for this guide are building officials, engineers, architects, building owners, emergency managers, and interested citizens.

The CD–ROM, FEMA 154CD, contains PowerPoint slides with instructor notes; the *RVS Student Manual* (FEMA 154SM); data collection forms; and PDF- and text-file versions of FEMA 154.

Rapid Visual Screening of Buildings for Potential Seismic Hazards: Supporting Documentation. Second Edition. (FEMA 155)

This companion document to the Rapid Visual Screening (RVS) handbook (FEMA 154) provides the technical basis for the updated RVS procedure. The document summarizes results from the efforts to solicit user feedback and describes in detail the development of the Basic Structural Hazard Score and the Score Modifier.

Seismic Rehabilitation of Federal Buildings: A Benefit/Cost Model. Volume 1: A User's Manual. (FEMA 255)

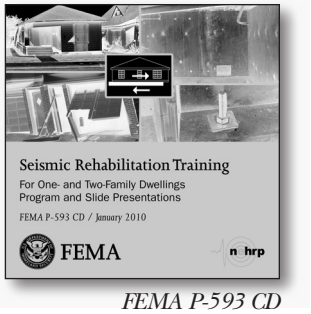
This user's manual and accompanying software present a second-generation benefit-cost model for the seismic rehabilitation of Federal and other government buildings. The benefit-cost methodology provides facility managers, design professionals, and other decision makers with estimates of the benefits (avoided damages, losses, and casualties) of seismic rehabilitation and the estimated costs needed to implement rehabilitation. The methodology also generates detailed scenario estimates of damages, losses, and casualties. A tutorial and benefit-cost analyses of eight Federal buildings are included. (Note: Computers must have Windows and Quattro Pro in order to operate the software, which is provided on 3½-inch diskettes.)

Seismic Rehabilitation of Federal Buildings: A Benefit/Cost Model. Volume 2: Supporting Documentation. (FEMA 256)

This supporting documentation contains background information for FEMA 255, including information on valuing public-sector services, discount rates and multipliers, the dollar value of human life, and technical issues that affect benefit-cost analysis, such as seismic risk assessment and sensitivity analysis.

Seismic Rehabilitation Training for One and Two Family Dwellings: Program and Slide Presentations. (FEMA P-593CD)

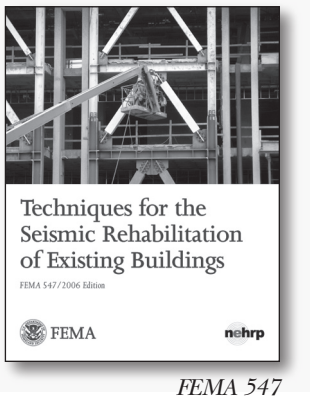
This CD-only product contains PowerPoint slide presentations, an instructional guide, and speaker's notes for training contractors, code officials, and other parties interested in the seismic retrofitting of existing light frame dwellings. This product has been used by the International Code Council as the basis for a series of webinars that have been presented to its membership.



FEMA P-593 CD

Techniques for the Seismic Rehabilitation of Existing Buildings. 2006 Edition. (FEMA 547)

This publication documents common seismic rehabilitation or retrofitting techniques used for buildings represented in the set of standard building types presented in FEMA seismic publications. It includes a wide variety of techniques that have been developed and used for repair and retrofitting of earthquake-damaged and seismically deficient buildings.



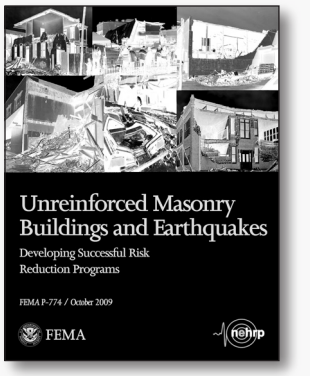
FEMA 547

Typical Costs for Seismic Rehabilitation of Existing Buildings. Volume 1: Summary. Second Edition. (FEMA 156)

This publication provides a methodology to estimate the costs of seismic rehabilitation projects at various locations in the United States. This edition is based on a sample of almost 2,100 projects, with data collected using a standard protocol, strict quality control verification, and a reliability rating. A sophisticated statistical methodology applied to this database yields cost estimates of increasing quality and reliability as more and more detailed information on the building inventory is used in the estimation process. Guidance is also provided to calculate the range of uncertainty associated with this process.

Typical Costs for Seismic Rehabilitation of Existing Buildings. Volume 2: Supporting Documentation. Second Edition. (FEMA 157)

This document is a companion volume to FEMA 156. The document provides an in-depth discussion of the approaches and methodology that were used in developing the second edition of FEMA 156.



FEMA P-774

Unreinforced Masonry Buildings and Earthquakes: Developing Successful Risk Reduction Programs. (FEMA P-774)

This publication provides guidance on reducing the risks from unreinforced masonry (URM) buildings in seismically active areas. URM buildings are typically the most vulnerable to earthquake damage and the type of construction that is most commonly singled out for voluntary and mandatory seismic risk reduction programs. The document includes illustrations and photographs of URM buildings and describes their seismic vulnerabilities. It discusses policy and regulatory issues that often must be considered, such as retrofit costs, the economic viability of older buildings, numbers of occupants and types of use, and historic or architectural values. Rather than prescribing a rigid sequence of steps for URM risk reduction, FEMA P-774 documents a wide variety of successful approaches that have been developed across the United States.

Nonstructural Components

Installing Seismic Restraints for Duct and Pipe. (FEMA 414)

This is one of three fully illustrated guides that show equipment installers how to attach mechanical equipment (FEMA 412), electrical equipment (FEMA 413), and duct and pipe (FEMA 414) to buildings to minimize earthquake damage. The guides describe various types of equipment and each includes a chart identifying the types of recommended equipment, the configuration for restraint, and the type of attachment needed. Step-by-step instructions and precautions for each type of equipment and methods for installing the equipment are included. Examples of anchoring and seismic-restraint devices; attachment types and instructions for installing equipment in different configurations; and special cases for housekeeping pads, cable assemblies, supports for control panels, and residential equipment are included. The publications do not cover non-building structural framing required to elevate equipment above the floor.

Installing Seismic Restraints for Electrical Equipment. (FEMA 413)

This guide provides equipment installers with information on how to attach electrical equipment to buildings to minimize earthquake damage. Many examples of attachments are presented, including anchors and seismic restraints. An electrical danger instruction chart and safety requirements and codes are included.

Installing Seismic Restraints for Mechanical Equipment. (FEMA 412)

This guide shows equipment installers how to attach mechanical equipment to a building to minimize earthquake damage. Many examples using anchoring and seismic-restraint devices are included. The guide begins with a list of various types of equipment and includes a chart that identifies the equipment, the recommended configuration for restraint, and the type of attachment needed. The second section provides examples of attachment types with instructions for installing equipment in different configurations. The third section provides examples of anchors, showing various types of anchors used to connect equipment to a building. The fourth section presents special cases, including supports for control panels and residential equipment.

Progression of FEMA's Existing-Buildings Guidance

Initial Rapid Visual Screening

- FEMA 154, *Rapid Visual Screening of Buildings for Potential Seismic Hazards*
  - A rapid survey of buildings to quickly determine which ones may present a hazard and which ones do not.

Seismic Evaluation

- American Society of Civil Engineers consensus standard ASCE/SEI 31
  - A more detailed seismic evaluation to determine the level of risk.
- Based on FEMA 310, *Handbook for the Seismic Evaluation of Buildings*
  - No longer available from FEMA, but is available on the *Whole Building Design Guide* from the National Institute of Building Sciences at http://www.wbdg.org/ccb/FEMA/ARCHIVES/fema310.pdf.

Seismic Retrofitting

- American Society of Civil Engineers consensus standard ASCE/SEI 41
  - How to seismically retrofit an existing hazardous building.
  - Referenced in the International Existing Building Code (IEBC).
- Based on FEMA 356, *Pre-standard for Seismic Rehabilitation of Buildings*
  - Still available from FEMA.

Seismic Retrofitting Techniques

- FEMA 547, *Techniques for the Seismic Rehabilitation of Existing Buildings*
  - A FEMA guide on different techniques for seismically retrofitting an existing building based on construction type and level of hazard.

Incremental Seismic Rehabilitation Series

- FEMA 395 – Schools
- FEMA 396 – Hospitals
- FEMA 397 – Offices
- FEMA 398 – Apartments
- FEMA 399 – Retail
- FEMA 400 – Hotels
- FEMA 420 – *Engineering Guideline for Incremental Seismic Rehabilitation*
  - Provides engineering support guidance for the series.

Guidance on Reducing Damage to Nonstructural Components and Contents

- FEMA E-74, *Earthquake Hazard Mitigation for Nonstructural Elements*
  - Online guide provides techniques on reducing risk from damage.

Guidance on Typical Costs of Retrofitting

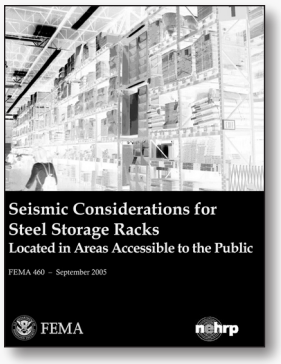
- FEMA 156, *Typical Costs for Seismic Rehabilitation of Existing Buildings*

Reducing the Risks of Nonstructural Earthquake Damage: A Practical Guide. Third Edition. (FEMA 74)

This well-illustrated publication describes the sources of nonstructural earthquake damage and provides information on effective methods of reducing potential risks from such damage. The guide assists in identifying potential hazards and provides specific guidance on upgrades that readers can do themselves. The guide contains diagrams and photographs, a glossary, references, and an annotated bibliography for those who wish additional information. A nonstructural inventory form, a checklist of nonstructural earthquake hazards, and an explanation of nonstructural risk ratings are included as appendices. The target audiences for the guide are building owners, facility managers, maintenance personnel, homeowners, store or office managers, business proprietors, organizational department heads, and others concerned with building safety and the continuation of business.

Reducing the Risks of Nonstructural Earthquake Damage: A Practical Guide. Fourth Edition. (FEMA E-74)

A web-based fourth edition of this publication was recently released on the Internet. It has been updated and redesigned for use online and expanded to include more examples, complete with photos of actual damage and details illustrating correct mitigation measures. The new online format makes it simple to browse and print out relevant details. The publication is located at http://www.fema.gov/plan/prevent/earthquake/fema74/index.shtm or http://www.atcouncil.org/FEMA74/FEMA74index.html.



FEMA 460

Seismic Considerations for Steel Storage Racks Located in Areas Accessible to the Public. (FEMA 460)

This report highlights issues for consideration in the seismic design, installation, ongoing inspection, maintenance, and use of steel pallet storage racks located in areas of retail warehouse stores and other facilities accessible to the general public. (The considerations apply only to single selective steel pallet storage racks with contents elevated 8 feet or more above the ground.) Included are a review of the performance of storage racks in past earthquakes; a history of the development of codes and standards used for storage-rack design and information on current storage-rack design practices; guidance on recommended performance goals and design requirements for storage racks; guidelines for implementation responsibilities associated with the specification, procurement, and installation of pallet storage racks; suggested guidance for securing contents; recommendations for operations and use; suggested guidance for quality assurance programs; a discussion of current and past storage-rack research and testing; suggestions for post-earthquake inspections; and proposed modifications to seismic design provisions and standards for racks. Most of the report is intended for all readers with an interest in the seismic protection of steel single selective pallet storage racks and their contents. Chapters 4 through 6 and Appendices A through D are very technical and will be of interest primarily to rack-design engineers and seismic code and standards writers.

Lifelines

Collocation Impacts on the Vulnerability of Lifelines during Earthquakes with Applications to the Cajon Pass, California. (FEMA 226)

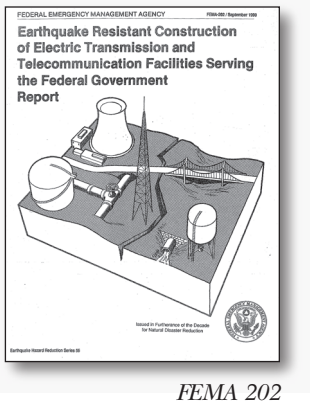
This report presents a new analytical method for identifying the increase in the seismic vulnerability of individual lifeline systems (communication systems, electric power systems, fuel pipelines, and transportation lifelines) due to their proximity to other lifelines in the Cajon Pass. The method calculates a parameter that can be used to adjust the damage-state values for shaking as determined by the Applied Technology Council's ATC–13 damage probability matrices. The primary objective of the study was to determine how the time to restore full service would be affected by the collocation of several types of lifelines in the same congested corridor. The new method is applied to the Cajon Pass lifelines. The design program, AutoCAD, is used to develop overlays of the lifeline routes with seismic and geologic information presented in the inventory report (FEMA 225).

Collocation Impacts on the Vulnerability of Lifelines during Earthquakes with Applications to the Cajon Pass, California: Study Overview. (FEMA 221)

This report summarizes a study of lifeline systems located along the Cajon Pass in southern California. The study included analysis of communication lifelines, electric power lifelines, fuel pipelines, and transportation lifelines. The report evaluates how collocation may influence each lifeline's seismic vulnerability. A brief description of the screening tool developed during the study is provided.

Earthquake Resistant Construction of Electric Transmission and Telecommunication Facilities Serving the Federal Government. (FEMA 202)

This report summarizes a National Institute of Standards and Technology study that reviewed measures implemented by Federal agencies to protect electric power transmission and telecommunication lifelines against seismic hazards. The report examines the seismic vulnerability of these lifelines and discusses current standards and design criteria. Seismic retrofitting techniques for components and systems are reviewed, including the benefits of retrofitting versus gradual replacement. A summary of Federal practices in the design of new facilities and the retrofit of existing facilities is included.



FEMA 202

Earthquake Resistant Construction of Gas and Liquid Fuel Pipeline Systems Serving or Regulated by the Federal Government. (FEMA 233)

This report summarizes the vulnerability of gas and liquid-fuel pipeline systems to damage in past earthquakes. The report lists the available standards and technologies that can protect such facilities against earthquake damage. An overview of measures taken by various Federal agencies to protect pipeline systems is presented. The appendix presents summaries of statements made by representatives of Federal agencies and other organizations contacted during the study.

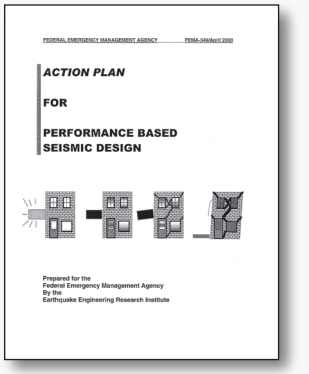
Inventory of Lifelines in the Cajon Pass, California. (FEMA 225)

This report provides an inventory of the major lifeline systems in the Cajon Pass. The report describes the earthquake and geologic analysis tools available to identify and define the level of seismic risk to those lifelines. The vulnerabilities resulting from the siting of multiple lifeline systems in confined and at-risk areas due to their interactions in natural and man-made disasters are evaluated. Potential mitigation techniques for communication lifelines, electrical power lifelines, fuel pipelines, and transportation lifelines are identified. Detailed maps indicate lifeline locations. The report also discusses seismic hazards and predictive models for evaluating the damage potentials associated with the various seismic hazards.

Seismic Vulnerability and Impact of Disruption of Lifelines in the Conterminous United States. (FEMA 224)

This report provides a national overview of lifeline seismic vulnerability and the impact of lifeline disruptions. Both site-specific lifelines and extended lifeline networks are examined. Included is a review of electrical, water, transportation, and emergency-service systems. The vulnerability estimates and impacts are presented in terms of estimated direct damage losses and indirect economic losses. The report also presents hazard mitigation measures and their expected benefits and recommendations for future work.

Performance-Based Design



FEMA 349

Action Plan for Performance Based Seismic Design. (FEMA 349)

This document, published as a "final draft," explores the steps required to successfully implement performance-based seismic design (PBSD). Topics discussed include the need for changes in current seismic design practice, the definition of performance-based design, and the products necessary for its effective adoption. These products include: 1) a Planning and Management Program; 2) Structural Performance Products (SPP); 3) Nonstructural Performance Products (NPP); 4) Risk Management Products (RMP); 5) PBSD Guidelines; and 6) a Stakeholders' Guide. The costs involved in obtaining both a basic framework for PBSD implementation and full implementation of PBSD are also outlined. This document has been superceded by FEMA 445, but is being maintained by FEMA for reference purposes.

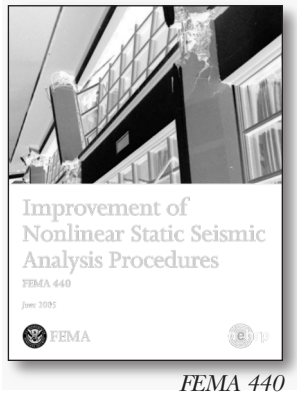
Effects of Strength and Stiffness Degradation on Seismic Response. (FEMA P-440A)

This document is a follow-on publication to *Improvement of Nonlinear Static Seismic Analysis Procedures* (FEMA 440). It provides information that will improve nonlinear analysis for cyclic response, considering cyclic and in-cycle degradation of strength and stiffness. Recent work has demonstrated that it is important to be able to differentiate between cyclic and in-cycle degradation in order to more accurately model degrading behavior, while current practice only recognizes cyclic degradation, or does not distinguish between the two. The material contained within this publication is expected to improve nonlinear modeling of structural systems, and ultimately make the seismic retrofit of existing hazardous buildings more cost-effective.

Improvement of Nonlinear Static Seismic Analysis Procedures. (FEMA 440)

This state-of-the-art resource captures the latest advances in nonlinear static analysis. It evaluates FEMA and Applied Technology Council (ATC) procedures for estimating the response of structures to ground shaking and attempts to address the significantly different results in estimates of maximum displacement that these procedures generate. This report sets the stage for future improvements to FEMA 356 or the ATC report, *Seismic Evaluation and Retrofit of Concrete Buildings* (ATC–40).

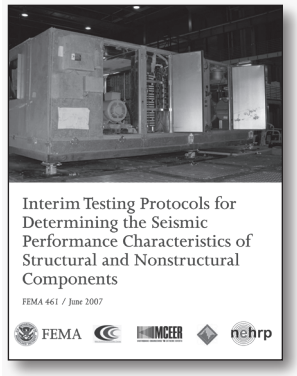
The CD–ROM, FEMA 440CD, June 2005, contains the document (FEMA 440) and supplementary summaries in PDF files.



FEMA 440

Interim Testing Protocols for Determining the Seismic Performance Characteristics of Structural and Nonstructural Components. (FEMA 461)

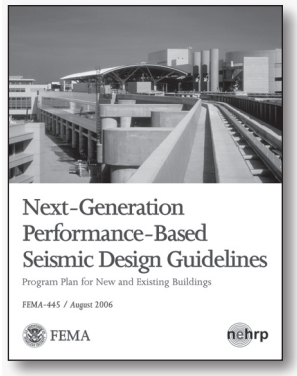
This publication was developed under FEMA's ongoing next-generation performance-based seismic design (PBSD) project with the Applied Technology Council, and is one of the first major accomplishments in carrying out the program plan described in FEMA 445. FEMA 461 provides methodologies that can be used to measure the seismic performance of buildings' structural or nonstructural components in a consistent and comparable manner. It describes in detail two laboratory testing protocols that determine fragility functions for various building systems and components. The first protocol, Quasi-Static Cyclic Testing of Structural and Nonstructural Components and Systems, can be used to test shear walls, beam-column assemblies, drywall partitions, cladding panels, pipes, ducts, and other elements whose behavior is sensitive to the relative motion of several floors or vertical connections within a building. The second protocol, Shake Table Testing of Structural and Nonstructural Components and Systems, is designed for testing mechanical and electrical equipment and other elements that are sensitive to the dynamic effects of motion imparted at a single point of attachment. Although these protocols are intended as interim methods that will be finalized over time as they are used and evaluated by researchers nationwide, they are nevertheless a significant step forward in the development of PBSD.



FEMA 461

Next-Generation Performance-Based Seismic Design Guidelines: Program Plan for New and Existing Buildings. (FEMA 445)

This publication is a step-by-step program plan for the current FEMA project with the Applied Technology Council to develop next-generation performance-based seismic design procedures and guidelines for structural and nonstructural components in new and existing buildings. The plan provides background information on current code design procedures, introduces performance-based seismic design concepts, identifies improvements needed in current seismic design practice, and outlines the tasks and projected costs for a two-phase program to develop next-generation performance-based seismic design procedures and guidelines.

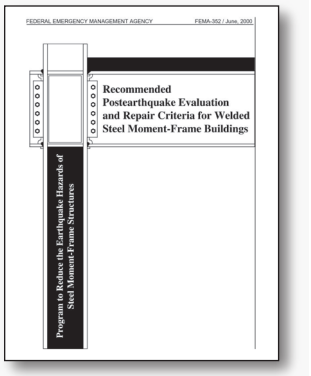


FEMA 445

Special Construction Types – Steel Moment-Resisting-Frame Buildings

A Policy Guide to Steel Moment-Frame Construction. (FEMA 354)

This guide addresses the social, economic, and political issues related to the earthquake performance of steel moment-frame buildings. Written for building owners, local community officials, and other non-technical audiences, the guide also discusses the relative costs and benefits of implementing the design criteria recommended in FEMA 350 through FEMA 353.



FEMA 352

Recommended Postearthquake Evaluation and Repair Criteria for Welded Steel Moment-Frame Buildings. (FEMA 352)

This report provides recommendations for performing inspections to detect damage in steel moment-frame buildings following an earthquake; evaluating the damaged buildings' safety in a postearthquake environment; and repairing damaged buildings. Chapters cover inspection and classification of damage; preliminary postearthquake assessment; detailed postearthquake evaluations; and postearthquake repair. The appendices include procedures for performance evaluation; sample placards that may be used to post buildings following preliminary postearthquake evaluations; and sample inspection forms that may be used to record damage detected in beam-column connections as part of a detailed postearthquake inspection program.

Recommended Seismic Design Criteria for New Steel Moment-Frame Buildings. (FEMA 350)

This resource document for organizations engaged in the development of building codes and standards provides recommended guidelines for the design and construction of steel moment-frame buildings and alternative performance-based design criteria. It supplements the *NEHRP Recommended Provisions for Seismic Regulations for New Buildings and Other Structures.* A series of pre-qualified connection details, as well as a detailed procedure for performance evaluation, are included.

Recommended Seismic Evaluation and Upgrade Criteria for Existing Welded Steel Moment-Frame Buildings. (FEMA 351)

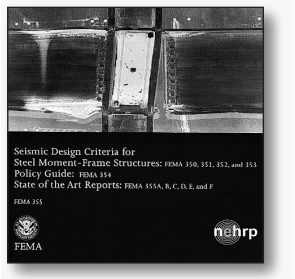
This publication provides recommended methods for evaluating the probable performance of existing steel moment-frame buildings in future earthquakes. It presents guidelines on how to retrofit these buildings for improved performance, a simplified procedure for estimating the probable postearthquake repair costs, and methods for developing building-specific vulnerability and loss functions for steel moment-frame buildings.

Recommended Specifications and Quality Assurance Guidelines for Steel Moment-Frame Construction for Seismic Applications. (FEMA 353)

This two-part publication provides recommended specifications for the fabrication and erection of steel moment-frames for seismic applications. Part One covers recommended specifications, including information on products; execution; welded joint and fabrication details; and quality control and assurance. Part Two outlines quality-assurance guidelines; contractor qualifications and quality tasks; quality-assurance agency qualifications and quality-assurance tasks; and recommended methods for determining whether structural steel materials, welded joints, and bolted joints meet the applicable standards. The recommended design criteria contained in FEMA 350, FEMA 351, and FEMA 352 are based on the standards contained in this document.

Seismic Design Criteria for Steel Moment-Frame Structures. (FEMA 355CD)

This CD–ROM contains a library of technical reports on the seismic design criteria, evaluation, repair, and specifications of steel moment-frame buildings. The CD–ROM includes four resource documents (FEMA 350 through FEMA 353) intended for the design, construction, repair, and upgrade of steel moment-frame structures that may be subject to the effects of earthquakes. The CD–ROM contains six reports (FEMA 355A–F) that provide detailed explanations of the basis for the design criteria and evaluation recommendations for base metals, welding, systems performance, connection performance, and past and predicted performance included in the resource documents.



FEMA 355CD

Special Construction Types – Evaluation and Repair of Concrete Buildings

Evaluation of Earthquake Damaged Concrete and Masonry Wall Buildings: Basic Procedures Manual. (FEMA 306)

This document provides practical criteria and guidance for evaluating earthquake damage to concrete- and masonry-wall buildings. Component Damage Classification Guides and Test and Investigation Guides are included. Detailed drawings accompany the text.

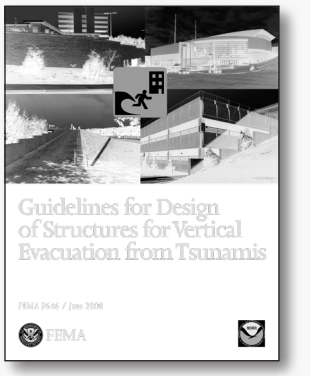
Evaluation of Earthquake Damaged Concrete and Masonry Wall Buildings: Technical Resources. (FEMA 307)

This document provides background and theoretical information to be used in conjunction with FEMA 306. Analytical and experimental findings are included, as well as information on the Component Damage Classification Guides.

The Repair of Earthquake Damaged Concrete and Masonry Wall Buildings. (FEMA 308)

This document provides practical guidance for the repair and upgrade of earthquake-damaged concrete- and masonry-wall buildings. Target audiences include design engineers, building owners and officials, insurance adjusters, and government agencies. The publication contains sections on performance-based repair design, repair technologies, categories of repair, and nonstructural considerations. The last section includes repair guides, which provide outline specifications for typical repair procedures.

Special Construction Types – Tsunami-Resistant Construction



FEMA P-646

Guidelines for Design of Structures for Vertical Evacuation from Tsunamis. (FEMA P-646)

Vertical evacuation is a programmatic issue central to the National Tsunami Hazard Mitigation Program, driven by the fact that there are communities along the west coast of the United States that are vulnerable to tsunamis that could be generated within minutes of an earthquake on the Cascadia Subduction Zone. Given that many coastal communities are located in areas that would be impossible to evacuate quickly, a large tsunami with very little warning could result in significant loss of life. Vertical evacuation structures provide a means to create areas of refuge within the tsunami inundation zone for communities in which evacuation out of the zone is not feasible. This document provides information and guidance on the following topics to assist in the planning and design of tsunami vertical evacuation structures: the tsunami hazard and its history; determining the tsunami hazard, including tsunami depth and velocity; different options for tsunami vertical evacuation structures; siting, spacing, sizing, and elevation considerations; determining tsunami and earthquake loads and related structural design criteria; and structural design concepts and other considerations.

Special Construction Types – Blast Resistance Benefits of Seismic Design

Blast Resistance Benefits of Seismic Design. Phase 1 Study: Performance Analysis of Reinforced Concrete Strengthening Systems Applied to the Murrah Federal Building Design. (FEMA 439A)

This series of publications was developed in response to the September 11, 2001 terrorist attacks and whether lessons learned in response to natural hazards could effectively be applied to protect building occupants from man-made threats. Important similarities between seismic and blast loadings lend themselves to such examination. This first publication was developed for reinforced concrete buildings using the bombing of the Alfred P. Murrah Federal Building in Oklahoma City in April 1995. That event was documented in *The Oklahoma City Bombing: Improving Building Performance Through Multi-Hazard Mitigation* (FEMA 277), which concluded that "application of mitigation strategies developed for FEMA for wind and earthquake can significantly improve blast resistance." That conclusion was based on the fact that, had the Murrah Building been designed with seismic resistance features, the progressive collapse could have been avoided. This report demonstrates that, with such seismic design features in place, the structural system would have been better able to dissipate and manage the blast load effects.

Blast Resistance Benefits of Seismic Design. Phase 2 Study: Performance Analysis of Steel Frame Strengthening Systems. (FEMA P-439B)

This is the second and last of a series of publications that was developed in response to the September 11, 2001 terrorist attacks and whether lessons learned in response to natural hazards could effectively be applied to protect building occupants from man-made threats. Important similarities between seismic and blast loadings lend themselves to such examination. The study described in this second publication duplicated the Phase 1 Murrah Federal Building study described in FEMA 439A, except that a steel frame building was examined instead of a reinforced concrete structure. A federally owned steel frame building located in an area of low seismic hazard was selected and a series of seismic strengthening designs were developed based on the original plans. The original building and the seismically strengthened designs were then evaluated using the same blast characteristics and modeling used in the Phase 1 study. The results were even more encouraging than in the first study, and demonstrated that, at least for this one example, a seismically strengthened steel frame building can provide a significant amount of resistance and redundancy.

Earthquake Training Resources

Earthquake Training Resource	Target Audience	Availability	Format
New Buildings			
FEMA P-749, *Earthquake-Resistant Design Concepts: An Introduction to the NEHRP Recommended Seismic Provisions.* This document provides a readily understandable explanation for non-technical users of the intent of seismic design in general and the *NEHRP Recommended Seismic Provision*s in particular, and how they fit into the Nation's codes and standards.	• Building officials • Engineers • Architects • Building owners • Emergency managers • Interested citizens	FEMA P-749 is expected to be available online and in print from FEMA by early 2011; go to http://www.fema.gov/plan/prevent/earthquake/pubindex_no.shtm. It will also be online at the Building Seismic Safety Council at http://www.nibs.org/index.php/bssc.	Publication

Earthquake Training Resource	Target Audience	Availability	Format
FEMA P-750, *NEHRP Recommended Seismic Provisions for New Buildings and Other Structures.* 2009 Edition. This edition of the *NEHRP Recommended Seismic Provisions* adopts the ASCE/SEI 7-05 standard by reference, and is presented in a new one-volume format with three parts. The Part 2 Commentary is an excellent training guide that explains seismic design using the ASCE 7 reference standard. Part 1 is the actual design criteria and Part 3 is a series of papers on emerging seismic design concepts. An accompanying CD contains the Provisions, design maps, and supporting materials.	• Structural engineers • Architects • Building officials	Available online, in print, and on CD from FEMA; go to http://www.fema.gov/library/viewRecord.do?id=4103. The Part 2 Commentary is included as part of the document. Complementary design examples (FEMA 751) and training materials (FEMA 752) are currently under development and expected to be available by late 2011.	Publication
FEMA 451, *NEHRP Recommended Provisions: Design Examples.* This publication provides a series of design examples for different construction materials and building configurations that demonstrate the design procedures used in the 2003 *NEHRP Recommended Seismic Provisions*.	• Structural engineers • Architects • Building officials	Available online and on CD from FEMA; go to http://www.fema.gov/library/viewRecord.do?id=2520. The content is currently being updated to the new 2009 edition of the Provisions.	CD Publication
FEMA 451B, *NEHRP Recommended Provisions for New Buildings and Other Structures: Training and Instructional Materials.* This CD–ROM contains PowerPoint slides presenting earthquake engineering training based on the 2003 *NEHRP Recommended Provisions*. The slides can be presented to engineers or architects by a qualified speaker, used by individuals, or applied as the basis for classroom instruction on earthquake-resistant design.	• Structural engineers • Architects • Building officials	Available on CD from FEMA; http://www.fema.gov/ library/viewRecord.do?id=2928. Available online from the Building Seismic Safety Council at http://www.nibs.org/index.php/ bssc/publications/2003/fema451btraining/. The content is currently being updated to the new 2009 edition of the Provisions.	PowerPoint slides – lecture format

Earthquake Training Resource	Target Audience	Availability	Format
Existing Buildings			
FEMA 154, *Rapid Visual Screening of Buildings for Potential Seismic Hazards: A Handbook.* Second Edition. This handbook can be used by trained personnel to identify potentially hazardous buildings before an earthquake. The RVS procedure helps users identify, inventory, and rank buildings according to their expected safety and usability after earthquakes.	• Building officials • Engineers • Architects • Building owners • Emergency managers • Interested citizens	FEMA 154 is available online, in print, and on CD (FEMA 154CD) from FEMA; http://www. fema.gov/library/viewRecord.do?id=3556. Complementary training materials, including PowerPoint slides, a student manual, and sample data collection forms, are available on FEMA 154CD.	FEMA 154 – Publication FEMA 154CD – PowerPoint slides
ROVER, *Rapid Observation of Vulnerability and Estimation of Risk (ROVER)*. ROVER, an electronic application of FEMA 154 designed for use with smart phones, is currently under development. It will also incorporate the ATC-20 post-earthquake assessment procedure.	• Building officials • Engineers • Architects • Building owners • Emergency managers • Interested citizens	ROVER and associated training are currently under development and are available only for pilot demonstration projects.	Application for hand-held smart phones
FEMA 395, *Incremental Seismic Rehabilitation of School Buildings (K–12)*. This manual provides school administrators and board members with the information they need to assess the seismic vulnerability of existing school buildings and to implement a program of incremental seismic rehabilitation.	• School administrators • School board members • Facilities managers • Engineers	FEMA 395 is available online and in print from FEMA; go to http://www.fema.gov/library/viewRecord.do?id=1980. A complementary FEMA training webinar is currently under development and is expected to be available by mid-2011.	Publication
FEMA 547, *Techniques for the Seismic Rehabilitation of Existing Buildings.* This document describes various seismic retrofitting techniques used for standard building types. The techniques are presented by building types, and cover a wide range of retrofitting situations and techniques. The training material is videotaped training course, with associated PowerPoint slides.	• Structural engineers • Design professionals	FEMA 547 is available online, in print, and on CD from FEMA; go to http://www.fema.gov/library/viewRecord.do?id=2393. A videotaped training course, will be available on the Earthquake Engineering Research Institute (EERI) website (http://www.eeri.org) for free viewing, with a charge for Continuing Education Unit (CEU) credit.	Publication

Earthquake Training Resource	Target Audience	Availability	Format
FEMA 74, *Reducing the Risks of Nonstructural Earthquake Damage: A Practical Guide.* Third Edition. This third edition of this publication describes sources of nonstructural earthquake damage and provides specific guidance on methods to reduce risks from such damage.	• Building owners • Facilities managers • Building officials • Engineers • Homeowners	FEMA 74 is available online and in print from FEMA; go to http:///www.fema.gov/library/viewRecord.do?id=3843. Complementary FEMA training materials are available from the Applied Technology Council; go to http://www.atcouncil.org.	FEMA 74 training materials PowerPoint slides – lecture format
FEMA E-74, *Reducing the Risks of Nonstructural Earthquake Damage: A Practical Guide.* Fourth Edition. This updated fourth edition of FEMA 74 has been significantly expanded to include many new elements. It is an electronic publication available only online. A complementary training webinar is under development and will be available in 2011.	• Building owners • Facilities managers • Building officials • Engineers • Homeowners	FEMA E-74 is available online from FEMA at http://www.fema.gov/plan/prevent/earthquake/fema74/index.shtm. It is also available online from the Applied Technology Council at http://www.atcouncil.org/FEMA74/FEMA74index.html.	Electronic publication
Residential			
FEMA 232, *Homebuilders' Guide to Earthquake Resistant Design and Construction.* This guide presents seismic design and construction guidance for one- and two-family light frame residential structures that can be utilized by homebuilders, homeowners, and other non-engineers, and provides information that supplements the 2003 edition of the International Residential Code. It includes background information on the principles of seismic resistance and how earthquake forces impact conventional residential construction, and more detailed information on architectural considerations.	• Homebuilders • Homeowners • Code officials • Architects	FEMA 232 is available online and in print from FEMA; go to http://www.fema.gov/library/viewRecord.do?id=2103. Complementary FEMA training materials are under development.	Publication

Earthquake Training Resource	Target Audience	Availability	Format
FEMA P-593CD, *Seismic Rehabilitation Training for One- and Two-Family Wood-Frame Dwellings: Program and Slide Presentations.* This training material promotes seismic rehabilitation of one- and two-family dwellings, in order to reduce earthquake damage losses and increase dwelling habitability following moderate to major earthquakes. This is done by introducing the trainee to the effects of earthquakes on wood-frame dwellings, identifying common seismic vulnerabilities, and identifying rehabilitation approaches and available guidelines.	• Contractors • Building officials • Plans examiners • Architects • Engineers • Homeowners	Available on CD from FEMA; go to http://www.fema.gov/plan/prevent/earthquake/pubindex_no.shtm. Also available via webinar from the International Code Council; go to http://www.iccsafe.org.	FEMA P-593CD PowerPoint slides – lecture format Complementary training Webinar
Special Topics			
FEMA 454, *Designing for Earthquakes: A Manual for Architects.* This publication provides information for architects, presented in a form that is attractive and readable. It consists of chapters that provide the foundation for an understanding of seismic design, each authored by an expert in the field, and thus represents expert opinion rather than consensus. It is intended to explain the principles of seismic design for those without a technical background in engineering and seismology.	• Architects	FEMA 454 is available online and in print from FEMA; go to http://www.fema.gov/library/viewRecord.do?id=2418. Complementary FEMA training is available from the URS Corporation; go to http://www.urscorp.com.	FEMA 454 – Publication Complementary training PowerPoint slides – lecture format
FEMA P-767CD, *Earthquake Mitigation for Hospitals.* This training presents mitigation of nonstructural components for hospitals, including special equipment and unique infrastructure systems. Components such as medical equipment, shelving, filing systems, parapets, computer systems, and more, are all susceptible to damage if not properly secured. Furthermore, hospitals must remain operational during and after an earthquake. By using sound, cost-effective mitigation techniques, operations can be maintained and losses can be reduced, and in some cases eliminated.	• Hospital facilities managers • Hospital engineers • Hospital administrators • Other hospital personnel	Available on CD from FEMA; go to http://www.fema.gov/plan/prevent/earthquake/pubindex_no.shtm.	PowerPoint slides – lecture format

Index of FEMA Earthquake Publications

FEMA IS-22, ***Are You Ready? An In-depth Guide to Citizen Preparedness.***
Federal Emergency Management Agency. Washington, D.C., 2004

FEMA 74, ***Reducing the Risks of Nonstructural Earthquake Damage: A Practical Guide.*** **Third Edition.**
Wiss, Janney, Elstner Associates, Inc. Washington, D.C., 1994

FEMA E-74, ***Reducing the Risks of Nonstructural Earthquake Damage: A Practical Guide.*** **Fourth Edition.**
Applied Technology Council. Redwood City, CA, 2002

FEMA 83, ***Seismic Considerations for Communities at Risk.***
National Institute of Building Sciences, Building Seismic Safety Council. Washington, D.C., 1995

FEMA 154, ***Rapid Visual Screening of Buildings for Potential Seismic Hazards: A Handbook.*** **Second Edition.**
Applied Technology Council. Redwood City, CA, 2002

FEMA 155, ***Rapid Visual Screening of Buildings for Potential Seismic Hazards: Supporting Documentation.*** **Second Edition.**
Applied Technology Council. Redwood City, CA, 2002

FEMA 156, ***Typical Costs for Seismic Rehabilitation of Existing Buildings. Volume 1: Summary.*** **Second Edition.**
Hart Consultant Group, Inc. Santa Monica, CA, 1994

FEMA 157, Typical ***Costs for Seismic Rehabilitation of Existing Buildings. Volume 2: Supporting Documentation.*** **Second Edition.**
Hart Consultant Group, Inc. Santa Monica, CA, 1995

FEMA 159, ***Tremor Troop: Earthquakes – A Teacher's Package for K–6.*** **Revised Edition.**
National Science Teachers Association. Washington, D.C., 2000

FEMA 173, E***stablishing Programs and Priorities for the Seismic Rehabilitation of Buildings: Supporting Report.***
Building Systems Development, Inc. Washington, D.C., 1989

FEMA 174, ***Establishing Programs and Priorities for the Seismic Rehabilitation of Buildings: Handbook.***
Building Systems Development, Inc. Washington, D.C., 1989

FEMA 182, ***Landslide Loss Reduction: A Guide for State and Local Government Planning.***
Colorado Division of Disaster Emergency Services and Colorado Geological Survey. Washington, D.C., 1989

FEMA 198, ***Financial Incentives for Seismic Rehabilitation of Hazardous Buildings—An Agenda for Action. Volume 1: Findings, Conclusions, and Recommendations.***
Building Technology, Inc. Silver Spring, MD, 1990

FEMA 199, ***Financial Incentives for Seismic Rehabilitation of Hazardous Buildings—An Agenda for Action. Volume 2: State and Local Case Studies and Recommendations.***
Building Technology, Inc. Silver Spring, MD, 1990

FEMA 202, E***arthquake Resistant Construction of Electric Transmission and Telecommunication Facilities Serving the Federal Government.***
National Institute of Standards and Technology. Gaithersburg, MD, 1990

FEMA 216, ***Financial Incentives for Seismic Rehabilitation of Hazardous Buildings—An Agenda for Action. Volume 3: Applications Workshops.***

Building Technology, Inc. Silver Spring, MD, 1990

FEMA 221, ***Collocation Impacts on the Vulnerability of Lifelines during Earthquakes with Applications to the Cajon Pass, California: Study Overview.***
Federal Emergency Management Agency. Washington, D.C., 1991

FEMA 224, Seismic Vulnerability and Impact of Disruption of Lifelines in the Conterminous United States.
Applied Technology Council. Redwood City, CA, 1991

FEMA 225, ***Inventory of Lifelines in the Cajon Pass, California.***
INTECH, Inc. Potomac, MD, 1992

FEMA 226, ***Collocation Impacts on the Vulnerability of Lifelines during Earthquakes with Applications to the Cajon Pass, California.***
INTECH, Inc. Potomac, MD, 1992

FEMA 232, ***Homebuilders' Guide to Earthquake Resistant Design and Construction.***
Building Seismic Safety Council. Washington, D.C., 2006

FEMA 233, ***Earthquake Resistant Construction of Gas and Liquid Fuel Pipeline Systems Serving or Regulated by the Federal Government.***
National Institute of Standards and Technology. Gaithersburg, MD, 1992

FEMA 253, ***Seismic Sleuths: Earthquakes—A Teacher's Package for Grades 7–12.***
American Geophysical Union. Washington, D.C., 1994

FEMA 255, ***Seismic Rehabilitation of Federal Buildings: A Benefit/Cost Model. Volume 1: A User's Manual.***
VSP Associates, Inc. Sacramento, CA, 1994

FEMA 256, ***Seismic Rehabilitation of Federal Buildings: A Benefit/Cost Model. Volume 2: Supporting Documentation.***
VSP Associates, Inc. Sacramento, CA, 1994

FEMA 266, ***Creating a Seismic Safety Advisory Board: A Guide to Earthquake Risk Management.***
Seismic Safety Commission of California. Washington, D.C., 1995

FEMA 275, ***Planning for Seismic Rehabilitation: Societal Issues.***
National Institute of Building Sciences, Building Seismic Safety Council. Washington, D.C., 1998

FEMA 306, ***Evaluation of Earthquake Damaged Concrete and Masonry Wall Buildings: Basic Procedures Manual.***
Applied Technology Council. Redwood City, CA, 1999

FEMA 307, ***Evaluation of Earthquake Damaged Concrete and Masonry Wall Buildings: Technical Resources.***
Applied Technology Council. Redwood City, CA, 1999

FEMA 308, ***The Repair of Earthquake Damaged Concrete and Masonry Wall Buildings.***
Applied Technology Council. Redwood City, CA, 1999

FEMA 313, ***Promoting the Adoption and Enforcement of Seismic Building Codes: A Guidebook for State Earthquake and Mitigation Managers.***
Department of Urban and Regional Planning, University of Illinois at Urbana-Champaign. Washington, D.C., 1998

FEMA 315, ***Seismic Rehabilitation of Buildings: Strategic Plan 2005.***
Earthquake Engineering Research Institute. Washington, D.C., 1998

FEMA 349, ***Action Plan for Performance Based Seismic Design.***
Earthquake Engineering Research Institute. Washington, D.C., 2000

FEMA 350, ***Recommended Seismic Design Criteria for New Steel Moment-Frame Buildings.***
SAC Joint Venture Partnership. Washington, D.C., 2000

FEMA 351, ***Recommended Seismic Evaluation and Upgrade Criteria for Existing Welded Steel Moment-Frame Buildings.***
SAC Joint Venture Partnership. Washington, D.C., 2000

FEMA 352, ***Recommended Postearthquake Evaluation and Repair Criteria for Welded Steel Moment-Frame Buildings.***
SAC Joint Venture Partnership. Washington, D.C., 2000

FEMA 353, ***Recommended Specifications and Quality Assurance Guidelines for Steel Moment-Frame Construction for Seismic Applications.***
SAC Joint Venture Partnership. Washington, D.C., 2000

FEMA 354, ***A Policy Guide to Steel Moment-Frame Construction.***
SAC Joint Venture Partnership. Washington, D.C., 2000

FEMA 355CD, ***Seismic Design Criteria for Steel Moment-Frame Structures.***
SAC Joint Venture Partnership. Washington, D.C., 2001

FEMA 356, ***Prestandard and Commentary for the Seismic Rehabilitation of Buildings.***
American Society of Civil Engineers. Reston, VA, 2000

FEMA 366, ***HAZUS–MH Estimated Annualized Earthquake Losses for the United States.***
Federal Emergency Management Agency. Washington, D.C., 2008

FEMA 389, ***Communicating with Owners and Managers of New Buildings on Earthquake Risk.***
Applied Technology Council. Redwood City, CA, 2004

FEMA 395–400 and P-420, Incremental Seismic Rehabilitation Publications.
World Institute for Disaster Risk Management, Alexandria, VA; Building Technology, Inc., Silver Spring, MD; Melvyn Green & Associates, Inc., Torrance, CA; 2003–2007

FEMA 395, *Incremental Seismic Rehabilitation of School Buildings* (K–12).

FEMA 396, *Incremental Seismic Rehabilitation of Hospital Buildings.*

FEMA 397, *Incremental Seismic Rehabilitation of Office Buildings.*

FEMA 398, *Incremental Seismic Rehabilitation of Multifamily Apartment Buildings.*

FEMA 399, *Incremental Seismic Rehabilitation of Retail Buildings.*

FEMA 400, *Incremental Seismic Rehabilitation of Hotel/Motel Buildings.*

FEMA P-420, *Engineering Guideline for Incremental Seismic Rehabilitation.*

FEMA 412, ***Installing Seismic Restraints for Mechanical Equipment.***
Vibration Isolation and Seismic Control Manufacturers Association. Washington, D.C., 2002

FEMA 413, ***Installing Seismic Restraints for Electrical Equipment.***
Vibration Isolation and Seismic Control Manufacturers Association. Washington, D.C., 2002

FEMA 414, ***Installing Seismic Restraints for Duct and Pipe.***
Vibration Isolation and Seismic Control Manufacturers Association. Washington, D.C., 2002

FEMA 424, ***Design Guide for Improving School Safety in Earthquakes, Floods, and High Winds.***
Building Systems Development, Inc. Washington, D.C., 2004

FEMA 439A, ***Blast Resistance Benefits of Seismic Design. Phase 1 Study: Performance Analysis of Reinforced Concrete Strengthening Systems Applied to the Murrah Federal Building Design.***
U.S. Army Corps of Engineers, Engineering Research and Development Center. Champaign-Urbana, IL, 2005

FEMA P-439B, ***Blast Resistance Benefits of Seismic Design. Phase 2 Study: Performance Analysis of Steel Frame Strengthening Systems.***
U.S. Army Corps of Engineers, Engineering Research and Development Center. Champaign-Urbana, IL, 2010

FEMA 440, ***Improvement of Nonlinear Static Seismic Analysis Procedures.***
Applied Technology Council. Redwood City, CA, 2005

FEMA P-440A, ***Effects of Strength and Stiffness Degradation on Seismic Response.***
Applied Technology Council. Redwood City, CA, 2009

FEMA 445, ***Next-Generation Performance-Based Seismic Design Guidelines: Program Plan for New and Existing Buildings.***
Applied Technology Council. Redwood City, CA, 2006

FEMA 450, ***NEHRP Recommended Provisions and Commentary for Seismic Regulations for New Buildings and Other Structures. 2003 Edition.***
National Institute of Building Sciences, Building Seismic Safety Council. Washington, D.C., 2004

FEMA 451, ***NEHRP Recommended Provisions: Design Examples.***
National Institute of Building Sciences, Building Seismic Safety Council. Washington, D.C., 2006

FEMA 451B, ***NEHRP Recommended Provisions for New Buildings and Other Structures: Training and Instructional Materials.***
National Institute of Building Sciences, Building Seismic Safety Council. Washington, D.C., 2007

FEMA 454, ***Designing for Earthquakes: A Manual for Architects.***
Federal Emergency Management Agency. Washington, D.C., 2007

FEMA 460, ***Seismic Considerations for Steel Storage Racks Located in Areas Accessible to the Public.***
National Institute of Building Sciences. Washington, D.C., 2005

FEMA 461, ***Interim Testing Protocols for Determining the Seismic Performance Characteristics of Structural and Nonstructural Components.***
Applied Technology Council. Redwood City, CA, 2007

FEMA 474, ***Promoting Seismic Safety: Guidance for Advocates.***
The Mid-America Earthquake Center, the Multidisciplinary Center for Earthquake Engineering Research, and the Pacific Earthquake Engineering Research Center. Washington, D.C., 2005

FEMA B-526, ***Earthquake Safety Checklist.***
Federal Emergency Management Agency. Washington, D.C., 2005

FEMA 527, ***Earthquake Safety Activities for Children and Teachers.***
National Science Teachers Association. Washington, D.C., 2005

FEMA 528, ***Earthquake Home Hazard Hunt Poster.***
Federal Emergency Management Agency. Washington, D.C., 2005

FEMA 529, ***Drop, Cover, and Hold Poster.***
Federal Emergency Management Agency. Washington, D.C., 2005

FEMA 530, ***Earthquake Safety Guide for Homeowners.***
California Seismic Safety Commission. Washington, D.C., 2005

FEMA 531, ***The Adventures of Terry the Turtle and Gracie the Wonder Dog*****, Grades 3–6.**
Washington Military Department, Emergency Management Division. Washington, D.C., 2005

FEMA 547, ***Techniques for the Seismic Rehabilitation of Existing Buildings.***
Rutherford and Chekene, San Francisco, CA; Degenkolb Engineers, San Francisco, CA; Cobeen & Associates Structural Engineering, Inc., Lafayette, CA; Interagency Committee on Seismic Safety in Construction, Washington, D.C.; with coordination by Applied Technology Council, Redwood City, CA; 2006

FEMA 577, ***Design Guide for Improving Hospital Safety in Earthquakes, Floods, and High Winds: Providing Protection to People and Buildings.***
URS Corporation. San Francisco, CA, 2007

FEMA P-593CD, ***Seismic Rehabilitation Training for One and Two Family Dwellings: Program and Slide Presentations.***
Applied Technology Council. Redwood City, CA, 2010

FEMA P-646, ***Guidelines for Design of Structures for Vertical Evacuation from Tsunamis.***
Applied Technology Council. Redwood City, CA, 2008

FEMA P-646A, ***Vertical Evacuation from Tsunamis: A Guide for Community Officials.***
Applied Technology Council. Redwood City, CA, 2009

FEMA P-695, ***Quantification of Building Seismic Performance Factors.***
Applied Technology Council. Redwood City, CA, 2008

FEMA P-710CD, Earthquake Publications for Teachers and Kids.
Federal Emergency Management Agency. Washington, D.C., 2008

FEMA P-711CD, ***Earthquake Publications for Individuals and Homeowners.***
Federal Emergency Management Agency. Washington, D.C., 2008

FEMA P-712CD, ***Earthquake Publications for Community Planners and Public Policy Makers.***
Federal Emergency Management Agency. Washington, D.C., 2008

FEMA P-749, ***Earthquake-Resistant Design Concepts: An Introduction to the NEHRP Recommended Seismic Provisions.***
National Institute of Building Sciences, Building Seismic Safety Council. Washington, D.C., 2010

FEMA P-750, ***NEHRP Recommended Seismic Provisions for New Buildings and Other Structures. 2009 Edition.***
National Institute of Building Sciences, Building Seismic Safety Council. Washington, D.C., 2009

FEMA P-774, ***Unreinforced Masonry Buildings and Earthquakes: Developing Successful Risk Reduction Programs.***
Applied Technology Council. Redwood City, CA, 2009

FEMA

FEMA P-736
Catalog No. 08319-1